

**ATTITUDES OF LEARNERS TOWARDS  
PHYSICS AND CHEMISTRY**

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**ATTITUDES OF LEARNERS TOWARDS PHYSICS AND CHEMISTRY**

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**EDUCATION, UNIVERSITY OF DURBAN WESTVILLE.**

A faint, circular seal of the University of Durban Westville is visible in the background, partially obscured by the text. It features a central emblem surrounded by the university's name in English and Afrikaans.

**SUPERVISOR: PROF. JONATHAN JANSEN**

**JANUARY 1999**

## **DECLARATION**

**I, ROSHNI CHAGAN JIVAN, declare that the work presented in this declaration is original. The product is the result of my efforts through the professional guidance of the supervisor whose name and signature appear below.**

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## **ABSTRACT**

**The study investigated the attitudes of high school learners towards Physics and Chemistry. The learners were in Sastri College, a high school in Kwa-Zulu Natal. The study also investigated the relationship between attitude and performance. The sample consisted of 50, Grade 12, Physical Science learners.**

**The data was collected by means of a questionnaire, a semi - structured and individual interviews and the matriculation results from the Department of Education and Culture. The SPSS package was used to analysis the quantitative data. The interviews were used to qualify and elaborate on the statistical findings. The findings showed that majority of the learners had a positive attitude towards Physics while few learners had positive attitude towards Chemistry. It was also found that attitude did not affect the performance of the learners and there was no gender difference between attitudes and performance.**

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## **CHAPTER 1**

### **LEARNER ATTITUDES TOWARDS PHYSICAL SCIENCE**

#### **THE RATIONALE FOR THE STUDY**

##### **1.1 INTRODUCTION**

In South African schools, Grade Nine is the exit point for the compulsory phase of schooling. At this point, these high school learners are required to make significant decisions which will impact on their final years of schooling and, in many cases, their long term careers. Learners select matriculation subjects which they will study in their final three years of schooling (Grade 10,11 and 12). The selected subjects should enable them to obtain a matriculation certificate which qualifies them for higher education (university, technikon, etc) or employment. In South Africa, few learners select Physical Science, consisting of Physics and Chemistry components. Yet, Physical Science is a critical subject for the entrance into the scientific, technical and industrial fields of study or career placement. Given the small number of learners who study and succeed in Physical Science, for a technological society, I was interested in understanding the attitudes of high school learners towards Physics and Chemistry and the possible link to their performance in these subjects at the end of Grade 12.

The goal of this Chapter is to provide an overview of this study. It explains the purpose of the research, outlines the critical questions to be investigated describes the research methodology, provides a rationale for the study and specifies the limitations of the study.

The critical research questions pursued in this study are:

1. What is the attitude of learners towards Physics and Chemistry?
2. Why do learners have these attitudes towards Physics and Chemistry?
3. What is the possible relationship between these attitudes and the performance among the high school learners?

## **1.2 RATIONALE FOR THE STUDY**

I have been a Physical Science educator for 22 years. Over the years, I have noticed that my learners, in Grade 12, were anxious about their final examination. This was understandable as it was the first time they were writing two examination papers for Physical Science. The anxiety is amplified as this examination determines their future career choices.

I always boost the confidence of my learners before they write their examination. Some learners are very anxious and nervous about their Physics paper while others were more concerned about the Chemistry paper. They are not very confident when they enter the

examination room. Some learners feel that Physics is difficult while others feel that chemistry is difficult.

In my research, I want to determine the attitudes of the Science learners towards Physics and Chemistry and whether these attitudes affect their performance at the end of Grade 12.

The findings of this research would be useful to:

1. Educators of Physical Science who want to have a better understanding on the attitudes learners display towards Physics and chemistry.
2. Educators of Physical Science, to question their attitudes towards Physics and Chemistry, as the educators' attitudes are transferred to the learners.
3. Subject advisors, to use the findings, to develop workshops, which will help Science Educators to change the attitudes of learners towards Physics and Chemistry.
4. Researchers interested in the relationship between attitude and performance in the Physical Science education in South Africa.

### **1.3 METHODOLOGY**

The sample chosen for the research consists of Grade 12 learners from Sastri College, a high school in Kwa - Zulu Natal. The methodology included both quantitative and

qualitative methods of data collection. Data was collected using a questionnaire and interviews.

## **CRITICAL QUESTION ONE**

### **WHAT ARE THE ATTITUDES OF LEARNERS TOWARDS PHYSICS AND CHEMISTRY?**

A questionnaire, containing both open and closed-ended questions, was completed by the Physical Science, Grade 12 learners at Sastri College ( Appendix A ). Sixty eight (68) learners were studying Physical Science in Grade 12 but only 50 learners volunteered to answer the questionnaire. The closed - ended questions helped me to determine the learners' attitudes towards Physics and Chemistry, while the open-ended questions helped me in obtaining a greater insight into the learners' attitudes towards Physics and Chemistry. The data obtained was analysed using the SPSS, a statistical tool for the quantitative analysis of data. It will help me to determine the learners' attitude towards Physics and Chemistry.

The validity of the questionnaire was enhanced by the informal administration of the questionnaire to a group of Physical Science learners in a neighbouring school to detect ambiguity in wording and to elicit comment on any aspect of the questionnaire as a whole. After their responses were received, items were rephrased to ensure greater clarity and meaningfulness to learners.

## **CRITICAL QUESTION TWO**

### **WHY DO LEARNERS HAVE THESE ATTITUDES TOWARDS PHYSICS AND CHEMISTRY?**

From the 50 who answered the questionnaire, five learners who displayed a very positive attitude towards Physics and five learners who displayed a very positive attitude towards Chemistry, was selected for the semi - structured interviews. Sampling of these respondents was based on their responses to the questionnaire, i.e. (a) those who were very positive towards Physics; and (b) those who were very positive about Chemistry.

The validity of the interview instrument was strengthened by:

1. asking a group of experienced Physical Science educators for comment on the interview schedule. (The necessary changes were made to the existing documents after adhering to comments from peers.)
2. conducting the pilot interview with a colleague.

## **CRITICAL QUESTION THREE**

### **WHAT ARE THE POSSIBLE RELATIONSHIPS BETWEEN SCIENCE ATTITUDES AND THE PERFORMANCE AMONG HIGH SCHOOL LEARNERS?**

I obtained the 1998, Grade 12 , Physical Science results for Physics and Chemistry for the learners of Sastri College. This was obtained after a request was made to the Department of Education and Culture. Together with these results, I used the test results

and the trial examination results. These made up three sets of results. I compared the results of the two focus group with their attitudes towards Physics and Chemistry. I also did a quantitative analysis of the results and looked at the gender difference in learner responses.

#### **1.4 LIMITATIONS OF THE STUDY**

The data is limited in that I chose only one secondary school, Sastri College. I chose Sastri College as I teach there and it was easy to obtain permission from the principal and the parents and the willingness of the learners to co-operate and participate in the survey. The learners of Sastri College do not represent all the learners in Kwa-Zulu Natal. The results obtained, will however, be similar to that of the other learners.

#### **1.5 SUMMARY**

In this chapter, the purpose of the study and the critical questions were outlined. A brief description of the research methodology and the limitations of the study were also provided. The next chapter deals with a conceptual framework on the term attitude which will assist in the understanding of the concepts related to attitude. This is followed by a brief description of the implications of the literature review for the research.

## **CHAPTER 2**

### **LEARNERS ATTITUDE TOWARDS SCIENCE; A CRITICAL REVIEW OF LITERATURE**

#### **2.1 INTRODUCTION**

There is an established literature on the attitude of learners towards science ( Aiken & Aiken, 1969 ; Powell, 1962 ; Shrigley, 1988 ; Haney, 1964 ; Koballa & Crawley, 1985 ; Mungy, 1983). Studies have shown that the number of students studying Science in the secondary schools has decreased (Gallagher, 1917; Ayers & Price, 1975), that the number of girls studying Science is lower compared to boys ( Staberg, 1994 ; Shrigley, 1978 ; Rasanen, 1992; Levin, Saber & Libman , 1991/1992 ); that teachers and teaching styles affect attitude ( Mc Robbie & Fraser, 1993 ; Aiken & Aiken, 1996 ; Ebenzer & Zoller, 1993 ; Mc Millian & May, 1979 ; Shrigley, 1977 ; Pedersen, 1992 ); that attitude affects achievement ( Willson, 1983 ; Scibeci & Riley, 1986 ) and that attitudes can be changed (Pedersen, 1992 ; Johnson, Ryan & Schroeder, 1974 ; Shrigley, 1983 ; Haney, 1964 ; Dickinson & Flick, 1996 ; Harwood & Mc Mahnon, 1997).

The concept “attitude” is the focus of this research and the literature review. The purpose of this chapter is to present a review of the existing literature on attitudes towards Science. I reviewed the following issues related to “attitudes” and explained their value to my study:



- a) The relevant terminology and appropriate concepts associated with attitudinal studies.
- b) External influences on attitudes ;
- c) Decline in the number of learners studying Science ;
- d) Teachers and teaching styles ;
- e) Achievement and Science attitudes ;
- f) Gender and Science attitudes ; and
- g) Chemistry and Science attitudes.

I conducted a comprehensive search for international data sources (ERIC) and national databases (NEXUS – a database on current and completed research in Africa.) on the subject of learner attitudes towards Science. This enabled me to obtain the relevant literature. There was little research specifically related to attitudes towards Physics and Chemistry; I therefore had to look at attitudes towards Science or Physics or Chemistry. The literature review is based largely on studies carried out in North America and Europe, an observation that further motivated me to do this study in the African context.

## **2.2 A CONCEPTUAL FRAMEWORK FOR UNDERSTANDING “ATTITUDES”**

The purpose of this section is to present a framework for understanding the concept of “attitude”. Many scholars have attempted definitions of the concept “attitude”. This will

be outlined in this section. Attitudes and beliefs will also be discussed as this will assist in the understanding of the learner's attitude towards Physics and Chemistry.

### **2.2.1 ATTITUDE**

Aiken and Aiken (1969), and more recently, Shrigley, Koballa and Simpson ( 1988 ), explain that "attitude" is concerned with feeling or affect, a like or a dislike towards an object or situation. Koballa and Crawley ( 1985 ) explain that attitude is used to refer to a general and enduring positive or negative feeling towards an object or situation.

According to Hanley (1964) attitude is described by Allport as a mental and neutral state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to an object or situation with which it is related.

This is also supported by Shrigley, Koballa and Simpson ( 1988 ) who states that experience influences our hidden predisposition to respond to an object or situation. What does this mean? For example, a learner may have failed a particular subject. The learner is embarrassed. Whenever the subject arises, the learner will react negatively to it due to his or her experience.

Shrigley Koballa and Simpson ( 1978) sees attitude as an emotional filter. It allows us to rearrange our chaotic environment, such that the elements in it form some resemblance of

order. Attitude is seen as a readiness to respond, a set trap ready to spring. With this background, I will take attitude to mean a positive or negative emotion which directs a person's responses to an object or situation.

### **2.2.2 ATTITUDE TOWARDS SCIENCE AND SCIENTIFIC ATTITUDE**

Attitude towards Science is an important emotion that a learner possesses for it directs his or her response towards the subject. According to Koballa and Crawley ( 1985 ) this is important in that it directs the learners future behaviour towards Science, such as showing an, interest in working on a science project at home or in visiting a science museum.

Mungy ( 1983 ) states that "attitude" towards science" has 3 components. It involves cognition ( analytic and empirical ), value ( judgement, common day ) and attitude (emotional response, personal likes and dislikes).

Attitude towards Science is an emotion a learner displays towards Science and this must not be confused with scientific attitude. Scientific attitude does not deal with a personal like or dislike towards Science. It deals with attributes believed to be true or false (Shrigley, Koballa and Simpson 1988; Koballa & Crawley, 1985 ) by a community of scientists through concerns.

In this study, however, I am only interested in the attitude the learner displays towards Science. I will work with the learner's like or dislike towards Science.

### **2.2.3 ATTITUDE AND BELIEFS**

The beliefs that a learner has, can assist him or her to form an attitude towards an object or situation. This is supported by Koballa and Crawley ( 1985 ) who found that if a learner states that 'Science is too mathematical', the learner sees this as a fact and it will lead him or her to conclude that Science is difficult. The term "belief" is reserved for the information that the person accepts to be true. This information can be obtained from experience or by comments made by people. Beliefs contribute to the formation of attitudes.

The above is true in the school situation. Many learners do not want to study Science in the secondary senior phase, as they believe that Science is difficult. This information has often been obtained from previous learners or from their siblings. The information handed down was that Science was difficult and it required a lot of work. The learner believes this and develops a negative attitude to science.

#### **2. 2. 4 ATTITUDES ARE LEARNED**

This section will discuss how people obtain a particular attitude and if this attitude is permanent.

Koballa & Crawley ( 1985 ) state that attitudes are not inherited traits but they are learned predispositions acquired over a period of time, perhaps years, for example, fear of the dentist or fear of snakes.

The development of an attitude or the change in an attitude is brought about by social influences. They are learned from experience. This is supported by Shrigley koballas and Simpson ( 1988 ) who sees attitude as dynamic and something that can be changed. He sees attitudes as temporary but stable and they are enduring enough to be stable but transient enough to be changed.

This observation is important to my research. I believe that if learners have a negative attitude towards Science, this may be changed into a positive attitude. This will involve at least a change in teaching style and planned activities.

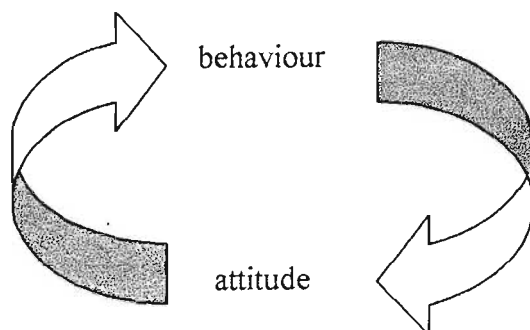
### 2. 2. 5 ATTITUDE CHANGE

Research shows that a change in attitude will lead to a change in behaviour. The discussion above shows that attitudes are learned and not inherited, therefore we are able to change a person's attitude. This enables a science educator to be able to change a learner's attitude towards Science. With a positive attitude, a learner will enjoy the lessons and his or her behaviour towards Science will improve. Shrigley, Koballa and Simpson ( 1988 ) states that the attitude towards an object or situation is like a spring. It will spring into action when faced with that particular object or situation. This implies that attitude determines behaviour.

Shrigley (1983) discusses Bern's self – perception model for attitude change. The model suggests that a change in behaviour can precede a change in attitude. A Science educator can change the behaviour of the learners and this in turn changes the learner's attitude towards science. The attitude can become more positive. An external change (behaviour) brings about internal change (attitude). The positive attitude now generates positive behaviour, which in turn, re – inforces positive attitude. The attitude – behaviour model is no longer directional :

behaviour → attitude

The model is better illustrated as a cycle :



Shrigley (1990) replaced Bern's bi-directional model with Meyer's cycle model. He sees attitude and behaviour as reciprocal, an endless chain or spiral where one feeds the other.

Educators can use this model in the classroom. A reluctant learner does the science activity and finds that it was fun and not dull as anticipated. The learner's behaviour towards Science will change. The successful behaviour now feeds attitude and the cycle is set in motion. The learner can break the endless chain at either the attitude or the behaviour link. Once in the cycle, the motion will spiral. The learner can spiral to a higher level with the Science attitude and behaviour feeding each other.

## **2. 2. 6 EXTERNAL INFLUENCE'S ON ATTITUDE**

We have established that a person's attitude is obtained from experiences. The learner is in constant contact with people. The discussion below will explain the influence the various people have on the learner. Koballa & Crawley ( 1985 ) state that the learner is influenced by the norms and goals of the peer group or the mentor.

### **2. 2. 6. 1 PARENTS**

Learners are very easily influenced by parental attitudes towards science. Parents play a vital role in the formation of attitudes in learners. In order to foster a positive attitude towards Science in learners, parents should be encouraged to influence their children in this regard. This can be done at parent – teaching conferences. Koballa & Crawley (1985) state that educators must encourage the parents to participate with their children in Science activities performed at home, for primary school learners, for example, germination of a seed or the building of an electric circuit. Parents of high school learners should be enlightened as to how the Science concepts learned by the learners will impact on the present and future career decisions.



With the parent's support, I find, in my experience, that the learners can develop a positive attitude towards Science.

#### **2. 2. 6. 2 PEER / SIGNIFICANT OTHERS**

Peer influence is very important to adolescents. They want to belong or fit with the group and the group's attitude influences the adolescent's attitude.

If a cheerleader / headgirl (a leader) sees science as masculine or a difficult subject and decides not to pursue science, this influences others. Koballa & Crawley ( 1985 ) suggests that social leaders / mentors can be convinced of the benefits that may be derived from the studying of science. Their new attitude towards science is likely to be passed on to their peers or groups who hold them in high esteem.

I have found that peers do play an important role in the choice of science as a subject in the secondary phase. Many of the learners do not want to study science in grade 10 because the present and the past learners have informed them that science is difficult and it requires a lot of work and sacrifice. This attitude towards science is negative and it influences the learners in grade 9 downwards. Research has also shown that in constructivist learning theory, children learn sciences by interacting with their peers.

### **2. 2. 6. 3 CULTURAL**

Society voices its opinion about Science today and its role in the future in relation to culture. These opinions affect the learner's attitudes towards science.

Many people in our society hold negative attitudes towards science. They suggest that for humankind to survive, scientific investigation must be sharply cultured ( Koballa & Crawley, 1985 ). Public discussion on nuclear energy and the use of chemical pesticides on agriculture shows the societies sceptism about its usefulness. Nuclear war will cause a collapse of society. These negative attitudes towards science are transferred to the young ones. When they reach high school, some among them, decide against the study of Science.

In order to prevent such negative perceptions of science, students must be exposed to the views of the other people in society, those who see science and technology making great advances to improve our lives and the quality of the environment. These positive views about Science must be presented to the students to assist in improving their attitudes towards Science.

As an educator, I have found that schools can assist in developing a positive attitude towards science by inviting members of the public in the scientific fields, for example, engineers, chemists, medical persons, etc, to deliver talks at assembly and to inform learners of the importance and the uses of science in the improvement of the lives of everyone. Due to the negative perception people have about science, we find a number of learners studying Science has declined. This is discussed below.

### **2. 3 DECLINE IN THE NUMBER DOING SCIENCE**

Science is an important subject. With a knowledge of science, discoveries and improvements are made in the medical field, environmental studies, designing of modes of transport, etc. Due to this, we require a large number of learners to study science to lead constantly, improving lives.

Many studies were conducted and the findings of these research studies were the same. Attitudes towards Science are high in the primary school but declines through junior high school ( Gallagher, 1971 ; Ayers & Price, 1975 ; Harns, Bybee & Yager, 1979 ; Welsh, 1984 as stated in Ebenzer & Zoller, 1983 ). These studies found that positive attitude's towards Science began to decline from grade 6 and extend through to junior high. Gallagher ( 1971 ) further found that the attitudes and perceptions of students at all grade levels towards Science as a school subject were negative. Ayers and Price ( 1975 ) found

that textbooks were the main vehicles of science instruction. There was very little emphasis on laboratory activities. Thus, practical work suffered, resulting in a further lack of interest.

This information is important to Science Educators at school, subject advisors and teacher educators. The attitudes of science educators in the primary schools has to be investigated. A positive attitude is to be instilled in these educators. Workshops should be held to bring about a change in attitude and to demonstrate simple experiments that can be carried out in the classroom to enhance the teaching of and create an interest in the subject. An inexpensive kit can be developed to enable the educators to carry out the experiments. By making the instructions interesting and active, the learners may enjoy science and may develop a positive attitude towards science.

#### **2.4 TEACHER AND TEACHING STYLES**

In this section, I will discuss the importance of the teacher and the teaching styles and the effect it has on the learner. This is important as it can assist educators to change their teaching styles such that it has a positive effect on the learner and develops a lasting interest in the subject.

Gallagher ( 1971) showed that children taught by teachers with a positive attitude towards science teaching showed a more positive attitude towards their science classes than children taught by teachers with a negative attitude towards Science teaching. This was supported by Mc Robbie & Fraser, 1993 ; Aiken & Aiken, 1969 ; Ebenzer & Zoller, 1993.

Ebenzer & Zoller ( 1993 ) state that the role of the teacher and their teaching style is important to all learners. If the teaching styles are not appealing, then the learners do not select science in grade 10 to 12. The teacher must change their traditional role from that of provider of knowledge to that of fellow learner, reciprocator, negotiator and facilitator. They also found that the students wanted the subject matter of science to relate to their everyday experiences. They view science as a method of understanding the world. Students felt that teachers could provide a more effective framework for studying science by incorporating the life experiences of the students.

Ebenzer & Zoller ( 1993 ) carried out a study in this field. The interpretation of their data collected was consistent with other studies of science classroom practices. The research has shown that the teacher has structured activities for the students. They listen, watch and take notes ( Tibis & Copie, 1982 ) and the teacher spends too much time feeding

them with facts and information ( Jedege, 1989 ). From the study, they arrived at the following conclusion that :

i) The teacher behaviour variable may be more influential than curriculum variables

(Gardiner, 1975);

ii) The pivot of any science educational programme is the teacher and the success of the

programme depends on how positive the teacher is to its implementation ( Jegede,

1989 );

iii) The science teacher plays an important role in mediating the effects of the learning

environment on student's attitude towards science. Classrooms must be made more

stimulating and it must provide a supportive environment, which will allow learners to

question and develop their interests in Science, achieving an important educational

goal ( Talton & Simpson, 1987 ).

Teaching style played a central role in determining student's attitudes towards Science. With this in mind Ebenzer & Zoller(1993) suggest that an INSET programme will assist in developing and fostering the teacher's capabilities of teaching Science, in ways in which the goals of science education will be achieved. An INSET programme is a teacher development programme aimed at improving teaching styles, knowledge and ability to carry out experiments. This is a neglected aspect of the South African education

policy. The programme must also assist the teacher to improve on their teaching styles, which will foster a more positive attitude towards science.

Shrigley ( 1971) suggests that principals and supervisors should reinforce the positive attitude of teachers by sanctioning the introduction of interesting Science materials into the local Science milieu and by planning to replace expendable materials.

Mc Millian & May (1979) stated that learners preferred a classroom which stressed active involvement and experience. The teacher's personality and interrelationship with students is a crucial variable for attitude formation. The classroom activities, rewards, assignments, teacher personality, relationship with pupils and pupil work is all controlled by the teacher. Therefore the teacher must assume a large part of both the responsibilities and challenges of developing positive attitudes of students towards Science. Johnson, Ryan & Schroeder, 1974 and Dickinson & Flick, 1996, state that the teacher is the role model and should use group techniques to facilitate understanding and acceptance of science.

I have found that many primary schools do not have science specialist teachers. Teachers take science as a filler subject, they do not know how to carry out the experiments and how to use the equipment the school has. They teach by doing the theory work alone. No experiments are conducted to make the lessons exciting and enjoyable. And hence learners develop a negative attitude towards science. This can be changed by attending

INSET programs. All science teachers should attend on a rotation basis. Such that the educator attends one INSET programme every three to four years. The programme will bring teachers up-to-date with new innovative ways to teach science, demonstrate simple experiments that can be carried out, have new text books on display, etc. The teacher will meet other science teachers and discuss problems or successes. At the end of this INSET programme the teacher feels revitalized and motivated to apply in the classroom what has been learnt in the programme. This will foster a positive attitude towards science.

School officials, supervisors and Science educators have to team up to provide teachers with the teaching skills and teaching strategies that will change the classroom climate to one of investigating Science ( Shrigley, 1971 ). Such an approach is supported by Shrigley, 1983 and Pederson, 1992. Many Science learners have produced poor results. Below, I will discuss the relationship between attitude and achievement.

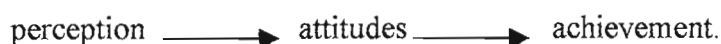
## **2. 5 ATTITUDE AND ACHIEVEMENT**

Is there a relationship between attitude and achievement?



Does a learner with a positive attitude perform better than a learner with a negative attitude ? From my readings, I have found that attitude does influence achievement. I will use this in my argument to prove that affect.

According to Wilson ( 1983 ), Baumrind's theory suggests that a positive effect will follow success in science achievement. Scibeci & Riley's research ( 1986 ) found that support for attitudes influence achievement. They found that the home environment, homework, parents' educational background, and student's perception of instruction, influences the attitudes of learners. These attitudes in turn influence achievement. From the above, Scibeci & Riley formed a casual chain :



The above supports the view that what the science teacher does in the classroom makes a difference in student's attitude and achievement. Scibeci & Riley ( 1986 ) state that the teacher must carry out his/her instructions in such a manner as to have a positive influence on the student's attitudes. These positive attitudes, in turn may have a positive influence on achievement. The relationship between attitude and gender is discussed below.

## 2. 6 ATTITUDE AND GENDER

The science curriculum plays an important role in influencing the learners. The science curricula of today is deeply rooted in boys grammar school. The Chemistry and Physics components are strongly connected with the academia. These subjects were developed

and constructed mostly by men in an environment which was and still is, masculine (Starberg, 1994). Science is seen as a 'MALE' ( Tolmie & Howe, 1993 ) dominated entity.

If the curriculum is male dominating, then it will have a negative influence on the attitude of girls towards science. This will result in a smaller number of female learners studying science. The above was supported by Aiken & Aiken, 1969 and Powell, 1962. They found that boys had a higher preference for science while girls had a lower preference for science when compared to other subjects.

The curriculum alone is not responsible for the decision to study Science. Attitude and performance is also important. Levin, Sabar & Libman ( 1991 ) found that boys perform better in Physical Science, especially in Physics but in the Biological Science, the boys' advantage became relatively small. This is according to studies carried out by Comber &

Keeves, 1973 ; HAEP, 1979 ;Erickson & Erickson, 1984. Boys performed better because they had a positive attitude towards the importance of Science.

Rasanen ( 1992 ) states that girls are interested in the relationship of Physics to the safety of people and the environment, to medical, social and ethical questions, as well as being interested in observing immediate processes and phenomena ( Hoffman & Lehrke, 1985 ; Hoffman, 1987 ). According to a German study, girls state that those kinds of connections, in which they would be interested, are seldom presented during the physics classes.

Rasanen ( 1992 ) supported the research carried out by Lie & Sjoberg ( 1984 ) and Sonensen ( 1985 ). They found that young people associate Physics with a masculine life style. Example : The topic electricity involves the building of circuits. Boys find this useful and enjoyable. They put this to good use in their later life. Girls do not find this useful and interesting. She also states that Physics is associated with the masculine territory. Success in Physics supports the masculine identity and motivates boys accordingly. I have found that in my teaching experience despite the Science curriculum being male dominated, there are a large number of girls studying science. This is a contradiction to Aiken and Aiken (1969) and Powell (1962). The Physical Science

Curriculum has two components, Physics & Chemistry. I will discuss the relationship between attitude and Chemistry.

## **2. 7 ATTITUDES TOWARDS CHEMISTRY**

Habraken ( 1996 ) found that there was a decline in the number of students studying science because mathematics and the mathematical logic dominated the chemistry classroom. He suggested that the students would be more comfortable with visual imagery, due to the availability of computers. With this, chemistry will become more interesting. Swanson (1995), supported the use of computers. Instead of making the lesson chalkboard, the teacher can use the computer as a resource.

In Swanson's study (1995), the use of computers in his lessons provided images, simulation of experiments, problems and other activities. The students enjoyed the lesson. They understood the concepts and calculations. They were actively involved in the problem – solving session. The students wanted less book – related work and more laboratory and class discussions. They stayed on a task longer and performed the calculations better with the computer.

Habraken (1986) found that children who played with video games had better perceptions. With this in mind, models, drawings and computers in combination with more graphic technology are playing an increasing role in the chemist's 'talking' and

‘writing’. With the use of the computer, he found that chemistry would become a visual science.

Harwood & Mc Mahnon ( 1997 ) found that a video series brought the abstract, distinct world of science into clear focus. It became meaningful. Students were more motivated and they developed a more positive attitude towards chemistry. They began to relate the chemistry to the world around them. The teacher will still be present to answer questions and clear any doubts.

The above information is very interesting. There are computer programmes dealing with chemistry topics but they are very expensive and the school cannot afford these. The governing bodies should make attempts to obtain these aids. They will make chemistry enjoyable and help to relate chemistry to the real world.

## **2. 8 IMPLICATIONS OF THE LITERATURE REVIEW FOR THIS STUDY**

The review of the literature allowed me to explore, understand and illuminate the various concepts and principles involved in this research towards science in general and Physics and Chemistry specifically.

From the literature review, I found various points of relevance for my study. I will focus on a few :

- 1) attitude is a positive or a negative emotion, which directs a person's responses to an object or situation;
- 2) learners believe that science is difficult and this develops a negative attitude towards science;
- 3) attitudes can be changed. This is important for the educator. A negative attitude towards science can be made positive;
- 4) behaviour and attitude feed each other in a cycle. The educator can change the behaviour and this in turn will change the attitude of learner towards science;
- 5) society, parents, peer and significant others influences the learners attitude towards Science. They must, therefore be exposed to more positive aspects of Science;
- 6) the teacher and the teaching styles must be such that it fosters a positive attitude in the learner. Supervisors, principals and fellow teachers can assist the teacher to do this;
- 7) a positive attitude influences achievement;

- 8) the science curriculum is male dominated and fewer girls study Science;
- 9) Chemistry can be made interesting and relevant to the real world by the use of computers and video programmes.

## **2. 9 SUMMARY**

This chapter clarifies the relevant terminology and it explains the concepts that are important to this study. A conceptual framework, dealing with the various aspects of attitude was presented. Information was also presented to show that society influences attitudes, that attitude and achievement are related and that chemistry needs technology to give the students an opportunity to do real science and to enjoy it. This chapter was concluded with the implications of the literature review for this study.

The next chapter will present the outline of research design and the procedures used in the research study.

## **CHAPTER 3**

### **RESEARCH METHODOLOGY**

#### **3.1 INTRODUCTION**

This chapter describes the methods used for data collection and analysis. It also explains the stages in which the data were collected and analysed. The nature of the learners and selection of the sample is also described. The steps taken to enhance the validity of the instrumentation is also outlined.

#### **3.2 THE LEARNING CONTEXT**

##### **3.2.1 THE SCHOOL**

Sastri College is a High School situated in the Durban Central area. It was built in 1924 by the Indian community to enable young boys to obtain a secondary education. Sastri College was designed and completed under the wise and able leadership of the RT Hon V.S. Srinivas Sastri, the first Agent General of the Government of India in South Africa. The school was to allow Indians to have education equality. The Indian donors financed the building while the Durban City Council, made a gift of 2 acres of land. The building was named after Srinivas Sastri and it was officially opened on the 27 January 1930. The school had 2 functions:



- 1.to provide a complete academic education up to and including matriculation standards and
- 2.to provide full-time professional teacher-training leading to recognised certification.

The school existed between 1930 and 1980 (last year of enrolment). A total of 11 412 students had been enrolled. Many of its alumni have distinguished themselves in business, industry, the professions, academia, politics, etc., within South Africa and outside.

Its door closed at the end of 1980 because of the drop in student numbers. Between 1980 and 1992 the Sastri College premises was occupied by the Cato Manor Technikon for its division of “Hair and Beauty Care” and “catering”.

In 1993, the doors of Sastri College reopened as a high school to accommodate the learners and educators from Gandhi Desai Secondary School, which was closed in 1992. I was an educator in Gandhi Desai Secondary School and moved over to Sastri College in 1993.

Sastri College has classes from Grade 8 to Grade 12 learners. It is co-educational and well-equipped in all academic departments.

General Science is compulsory in Grade 8 and Grade 9. At the end of Grade 9, learners make a subject choice. I teach Physical Science in Grade 10, 11 and 12. Each Science class has an average of 35 learners. The school offers Accounting, Physical Science and Computer Studies. The other course combinations offered are Commerce subjects without Physical Science.

### **3.2.2 The Learners**

The learners involved in this research belong to Grade 12A and Grade 12C. Grade 12A does a course with Computer Studies and Physical Science and has a roll of 26 with 9 girls and 17 boys. Grade 12C does an Accounting course and Physical Science and has a roll of 36, with 19 girls and 17 boys. The average age of these learners is about 17,5 years. I taught these learners Physical Science in Grades 11 and 12. I obtained permission to carry out research from the principal of the institute and from parents of the learners involved in the study.

### **3.3 Stages of Data Collection**

Data was collected in the following stages.

### **Stage 1**

A pilot study of the questionnaire was completed by 5 learners from the neighbouring institute, Durban Girls' Secondary School. This was done in the last week of August 1998. As a result of the examination the responses on the draft questionnaire, and the comments given, changes were made. The final questionnaire was prepared on the basis of these comments (See Appendix A).

### **Stage 2**

The questionnaire was administered to 50 Physical Science learners, 28 boys and 22 girls at Sastri College in grade 12 at the end of the trial examinations in mid-September 1998. Only those learners who were willing to answer the questionnaire were selected out of the 62 Physical Science learners.

### **Stage 3**

A semi-structured interview was conducted in the first week of December 1998 with 5 learners, who in their questionnaire responses, stated that they prefer Physics to Chemistry. This was done after they had completed their final matriculation examination. A copy of the interview schedule is presented as Appendix B.

#### Stage 4

In South Africa, the Physical Science learners write 2 papers, Paper I, Physics and Paper II, Chemistry. I made a request to the department of Education's Examination section in Kwa-Zulu Natal in March 1999. I wanted the results of 1998, Physical Science learners of Sastri College. I requested for the results of these 2 papers to enable me to compare the attitude with performance. The Department of Education made the results available to me in April 1999, for the sake of withholding the names of the Sastri College learners, I will number the results of the same from 1 to 50.

To obtain 3 sets of results for each learner in Physical Science and Chemistry, the following was done:

Physics      - Set 1    →    average of the first term tests  
                  Set 2    →    trial examination  
                  Set 3    →    final examination

Chemistry   - Set 1    →    average of the first term tests  
                  Set 2    →    trial examination  
                  Set 3    →    final examination

The three sets of results were used to find the relationship between attitude and performance.

## **Stage 5**

I found it difficult to get learners together to carry out the semi-structure interview with those learners who preferred Chemistry to Physics.

These learners are currently studying in tertiary institutes such as universities across the countries. At the end of June 1999, I managed to interview these 5 learners individually.

### **3.4 Collection of Data**

This section describes in detail the methods used for the collection of data.

#### **3.4.1 Administering the Questionnaire**

I obtained permission from the principal of Sastri College to administer the questionnaire.

I administered the questionnaire after the trial examination. It was collected immediately after completion. The purpose and value of the questionnaire was explained to the

respondents before commencement and they were asked to exercise care when completing it.

### **3.4.2 The Interview Process**

#### **3.4.2.1**

The responses to each question in the questionnaire was used to develop the interview. I selected 5 learners who liked Physics more than Chemistry for a semi-structured interview. This interview allowed respondents to discuss issues raised in the questionnaire. The purpose of the interview was to probe the learners' attitude towards Physics. The learners had been taught by me for the past two years, hence the interview was conducted in an informal and non-threatening way. The interview was recorded on an audio cassette, with the learners' permission and then transcribed. The interview lasted approximately 90 minutes. Transcripts of the interview are presented in appendix 2.

#### **3.4.2.2**

Five respondents were chosen for the interview process to learn more about their attitude towards Chemistry. They claimed in the questionnaire to prefer Chemistry over Physics. They were interviewed individually. The interview lasted approximately 30 minutes. The transcripts of this interview are presented in appendix 3.

### **3.4.2 The Matriculation Results**

The respondents wrote the matriculation examination in 1998. I requested the Physical Science, Paper 1 and Paper 2 results from Kwa-Zulu Natal examination section. The results were obtained in April 1999.

## **3.5 Qualitative Versus Quantitative Research**

### **3.5.1 Quantitative Research**

#### **3.5.1.1 Properties**

Crabtree and Miller (1992) state that the quantitative methods depend on larger samples selected randomly. This sampling concerns itself with representativeness. The sample should be a representative of some larger population to which one hopes to generalise the research findings. I used my learners as the larger sample. They represent all Matriculation Physical Science Learners.

According to Denzel and Lincon (1994), “quantitative studies emphasise the measurement and the analysis of causal relationships between variables and not the processes”. The quantitative researcher uses mathematical models and statistical tables and graphs. This was supported by Robinson (1998). I used the SPSS package to assist me to find the relationship between the variables.

My questionnaire was designed as a means of quantitative measurement of the learners attitude towards Physics and Chemistry. According to Paton (1980), quantitative measurement relies upon “the uses of interments that provide a standardized framework in order to limit data collection to provide certain predetermined responses or to analysis categories”. In my questionnaire, I used both the opened-ended and the closed-ended questions. The closed-ended questions are very restrictive. By its very design, it restricts the way in which people can answer questions and hence the results of any analysis of questionnaire responses are simply pre-determined (Robinson, 1998). In order to compensate for the underlying weakness of the closed questions, open-ended questions were also asked. This would give me a greater insight into the relationship between the variables.

### **3.5.1.2 Questionnaire Methodology**

#### **3.5.1.2.1 Designing a Questionnaire**

A questionnaire seems to be the accepted, convenient method used to obtain data from a large group of learners. It is not a perfect technique used to obtain the data. The questionnaire has to be designed very carefully to enable us to obtained important data. The questionnaire must be made as attractive as possible. It must appear to be easy to complete and it must be neat and well spaced out.



My questionnaire was neat and printed on one side of the paper. It consisted of 6 pages. Most of the questions require only a tick as the response. This made it possible to answer the questionnaire in less than 30 minutes. This enabled the respondents to answer the questionnaire without taking too much of their time. I chose the following Likert-type: 'strongly disagree', 'disagree', 'not sure', 'agree' and 'strongly agree'.

To ensure that the questions were understood and answered adequately, I took the following steps:

- a) The importance of the questionnaire was emphasised. The anonymity of the responses was assured.
- b) My supervisors and colleagues studied the questionnaire and all the ambiguities removed. This ensured that the questions were understood.
- c) Clear instructions were given to ensure that the respondents understood the procedure when answering the questionnaire.
- d) A pilot study was conducted.

Parfitt (1997) emphasises the importance of the pilot as the 'only means of putting right any major defects in the questionnaire before its final printing'. The objective of the

questionnaire pilot survey was to essentially test the questions being asked. As explained by Robinson (1998), in terms of the meaning of the questions we check to see whether the respondents understood particular terms and nuances and also to assess the difficulty of the questions.

#### **3.5.1.2.2 AIM OF MY QUESTIONNAIRE**

The questionnaire was designed to enable me to obtain information regarding the learners' gender, perception of their ability in Physical Science and attitude towards Physics and Chemistry. Close-ended questions were used to obtain the learners attitude towards Physical Science and Chemistry. There were two open-ended questions to give me greater insight into their attitudes towards Physical Science and Chemistry.

### **3.5.2 QUALITATIVE RESEARCH**

#### **3.5.2.1 PROPERTIES**

Paton (1990) cited in Crabtree and Miller (1992), that qualitative inquiry focuses in depth on relatively small samples, selected purposefully and the sampling concerns itself

with information richness. It explores meaning. The sampling is driven, according to Crabtree and Miller (1992), by the desire to illuminate the questions under study and to increase the scope or range of data exposed.

From the large group of learners, I chose a small sample of learners who claimed to like Physics and another who claimed to like Chemistry for my interview. The purpose being to obtain more information about their reasons for their likes and dislikes towards Physics and Chemistry.

Denzel & Lincoln (1994) state that qualitative research is multi-method in focus, involving an interpretive, naturalistic approach to its subject matter. Qualitative researches study things in their natural settings. They attempt to make sense of, or interpret the phenomena in terms of the meanings people bring to them. I interviewed my learners at Sastri College. They were familiar with and relaxed in these surroundings. The analysis of the interviews will assist me in interpreting their reasons for their attitudes towards Physics and Chemistry.

The use of multimethods or triangulation reflects an attempt to secure an in-depth understanding of the phenomenon in question (Denzel & Lincoln: 1994). 'Triangulation is not a tool or a strategy of validation, but an alternative to validation' (Denzel, 1989a,

1989b; Fielding and Fielding, 1986; Flick, 1992; 1994) in Denzel & Lincoln, 1994; . This is further supported by Crabtree & Miller, (1992).

Denzel & Lincoln (1992) see the qualitative researcher as a bricoleur – ‘Jack of all trades’ or a ‘do – it - yourself person’. They can perform a large number of diverse tasks, interviewing to observing to self – reflection. ‘The bricoleur understands that research is an interactive process shaped by his/her personal history, gender, social class, race and ethnicity and those of the people in the setting’ (Denzel & Lincoln, 1992). Taking this into account, I must distance my thoughts and background from the analysis.

Guba (1990) in Denzel & Lincoln (1994) state that qualitative research has an interpretive framework or paradigm, a ‘basic set of beliefs that guides action’. Denzel & Lincoln (1994) also state that all research is interpretive and it is guided by a set of beliefs and feelings about the world and how it should be studied and understood. Research cannot be value – free but I must try to distance my background and thoughts on my analysis. I will be very observant of the interviewees during the interview. I will be able to do this working with these learners on a daily basis.

The pilot study of my interview was conducted in Durban Girl’s Secondary. This enabled me to modify my questions such that it was understandable to all respondents. The pilot

study allows the researcher (Denzel & Lincoln, 1994) to focus on particular areas that may have been unclear previously.

- a) It is used to test certain questions.
- b) It allows me to establish effective communications patterns.
- c) It made me aware that working in the field is unpredictable a good deal of the time.

The qualitative researcher must be ready to adjust schedules, to be flexible about interview times and about adding and subtracting observations or interviews. I had to keep the above in mind, as the interview with learners who liked Chemistry did not take place in December 1998. When they did arrive for the interview, they came at different times. Due to this, I could not conduct a semi-structured interview.

### **3.5.3 LINKING QUALITATIVE AND QUANTITATIVE DATA**

The quantitative data obtained from the 50 questionnaires assisted the qualitative part of my study by enabling me to select a sample of learners for the interview based on their responses. My qualitative data complement my quantitative data. It also helped to validate, interpret and clarify the quantitative data and the quantitative data can verify the qualitative data (Miles & Huberman, 1994).

### **3.6 ANALYSIS**

The method used to analyse the data is discussed below. The analysis assisted me to obtain information about the learner's attitude towards Physics and Chemistry.

#### **3.6.1 ANALYSIS OF THE QUESTIONNAIRE**

The questionnaire was arranged in alphabetical order for Grade 12A and then Grade 12C. They were then numbered from 1 to 50. Each data item was then given a variable name and the categorical data were given a set of values. The variable names and labels were chosen so as to convey as much as possible about the data, which they described. Each question in Section A was coded. The alternatives for gender were numbered as follows:

male ... 1

female ... 2.

In Section B, the questions had 5 alternatives according to the Likert scale. These were used to measure the differences within the learners' responses. The responses were weighted according to the scale below;

strongly agree ..... 1

- agree ... ..2
- not sure ... ..3
- disagree ... ..4
- strongly disagree ....5

The codes were transferred from the questionnaire into a computer package, which was used for the data analysis. This is a methodical approach so that data entry errors were minimized. The PC based package (SPSS) is built around a spreadsheet into which data could be entered directly. I entered my data onto the spreadsheet. Once all data was entered, frequency tables and cross-tabulations were compiled using the various variables. These tables were converted into the form of graphs and then analysed.

The open-ended questions were coded. A crude listing of the main categories of answers were made and then the number of responses were recorded. Similar answers were combined. Parfitt (1997) contends that the coding process is a compromise between summarizing the data as concisely as possible and minimizing the loss of information that this process contains.

### 3.6.2 ANALYSIS OF THE INTERVIEW TRANSCRIPTS

The transcript of the interview was coded according to categories. Crabtree & Miller (1992), quoting Miles & Huberman (1984), recommended the structured approach to coding. This approach relies on a priori codes, based on either research question or the theoretical consideration or the literature review.

Crabtree & Miller (1992) state that the researcher must first develop a codebook, which will assist in organising segments of related texts for the use in interpretation and to search for conforming and disconfirming evidence of these interpretations. This allows the text to be coded rapidly. This method can become difficult when the codes are too long or have multiple ideas, which makes sorting more difficult.

Miles & Huberman (1994) states that codes speed up analysis. I coded my transcript according to the above discussion. Once coded, I did a frequency count for the different codes. This will assist me in identifying the key areas or points.



### 3.6.3. ANALYSIS OF RESULTS

The results of the first term average and the third term average was recorded as test 1. The trial examination results were recorded as test 2 and the final results as test 3. The results were coded as:

80% to 100 ... .. 1

70% to 80% ... .. 2

60% to 70% ... .. 3

50% to 40% ... .. 4

below 40 ... .. 5

I entered the codes into the computer into the SPSS package. I then compiled the frequency tables and the cross-tabulations. The tables were converted into graphs.

### 3.6.4 Limitations

During the collection of data, I experienced the following limitations:

1. All my grade 12,1998, Physical Science learners did not participate in the study. If they did, the sample would have been larger.

2. I could not conduct a semi-structured interview with the learners who liked chemistry as they were not available at the same time. I, therefore interviewed them individually. If I conducted a semi-structured interview, I could have been able to collect more data.

## **CHAPTER 4**

### **DATA ANALYSIS**

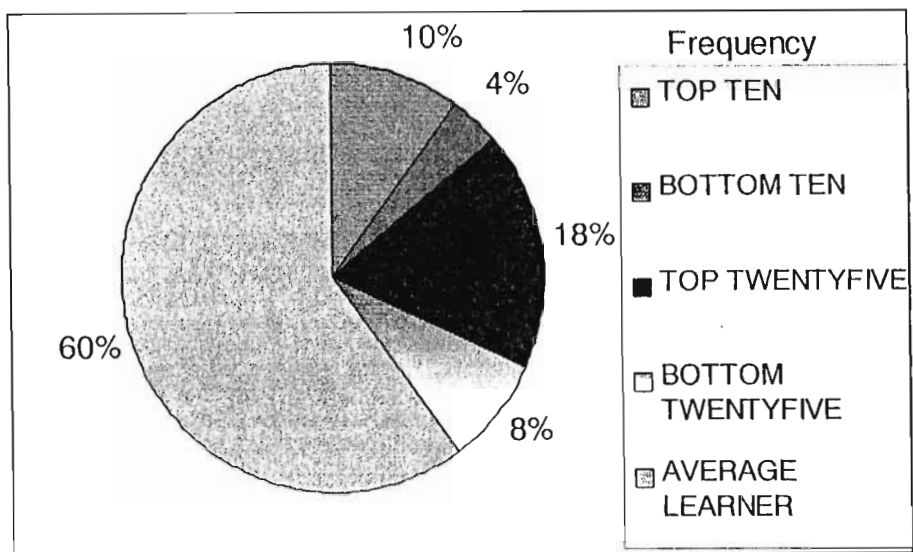
#### **4.1 INTRODUCTION**

In this chapter, I will discuss the data analysis in order to provide reasonable answers to the research questions of this study. The quantitative analysis of the questionnaire is designed to inform us of the learners attitude towards Physics and Chemistry. In South Africa, the Physical Science curriculum has two components, Physics and Chemistry. This questionnaire was answered by 50 Grade 12, Physical Science learners of Sastri College in 1998. The qualitative analysis of the interview indicated why the learners have these attitudes. The quantitative analysis of the learners' results informed us if there is a relationship between attitude and performance.

#### **4.2 QUANTITATIVE ANALYSIS OF QUESTIONNAIRE**

##### **4.2.1 PROFILE OF LEARNERS**

The questionnaire was answered by 50 learners, 28 boys and 22 girls. The respondents were asked to place themselves in a particular category according to their ability in Physical Science. With regards to the top 10% in the Physical Science class there were 10% of the sample, (4 boys and 1 girl), the top 25% in the class there were 18% of the sample, (4 boys and 5 girls) and 60% of the sample placed themselves as the average learner, (17boys and 13 girls). Refer to graph 4.1



### Ability in Physics

Figure 4.1

#### 4.2.2 MAIN FINDINGS

I will compare the attitudes of the sample towards Physics and Chemistry in this section. If offered as separate subjects, 66% of the sample, (20 boys and 14 girls) indicated that they will do Physics while 46% of the sample, (11 boys and 12 girls) indicated that they will do Chemistry.

In Physics and Chemistry, mathematics and explanations are used to assist in the understanding of the various topics. When asked if the mathematics aspect of the Physics was manageable, 49% agreed, (13 boys and 11 girls) while 78% agreed that the

mathematics in the Chemistry was manageable, (20 boys and 19 girls). (This is represented graphically in Graph 4.2 and Graph 4.3).

Figure 4.2

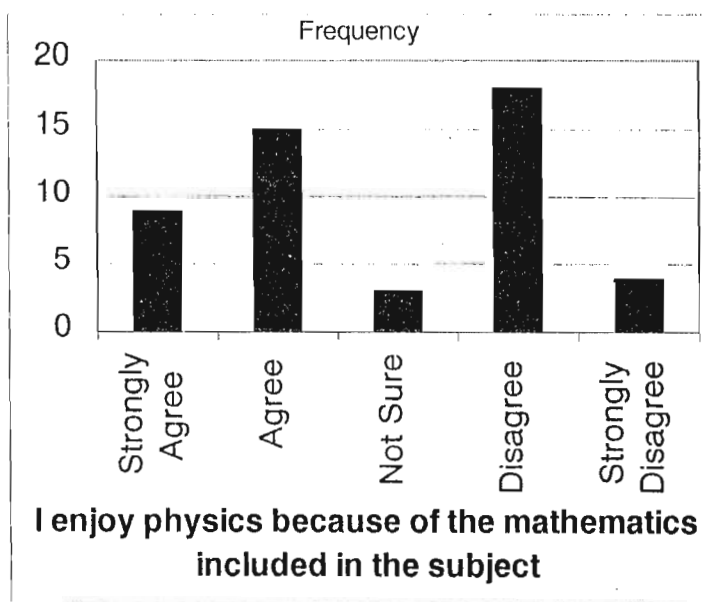
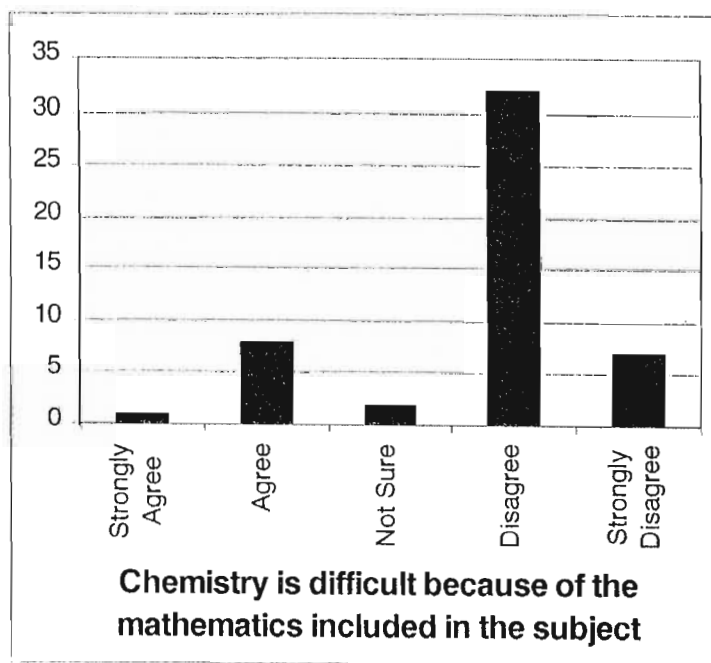


Figure 4.3



The explanation aspect of Physics was not difficult was agreed upon by 57% of the sample, (15 boys and 13 girls) but 56% of the learners found the explanation aspect of Chemistry difficult, (14 boys and 14 girls). See (Table 4.1 and Table 4.2).

Table 4.1

	Frequency	Percent
Agree	11	22.4
Not Sure	10	20.4
Disagree	21	42.9
Strongly Disagree	7	14.3
Total	49	100.00

**Physics is difficult because of the explanations required of me as a student.**

Table 4.2

	Frequency	Percent
Strongly Agree	3	6.0
Agree	10	20.0
Not Sure	9	18.0
Disagree	26	52.0
Strongly Disagree	2	4.0
TOTAL	50	100.0

**I enjoy chemistry because of the explanations I have to give.**

In the Physics and Chemistry curriculum, the syllabus has a number of experiments. These experiments enables the educator to make the learners understand the concept better. The learners enjoy the experiments as they now have a visual aspect to the topic

under discussion. Taking Physics into account, 72% of the sample found the experiments interesting while 86% of the learners found the Chemistry experiments interesting.

The Physics and the Chemistry curriculum has many everyday application explained to the learners. In Physics, they learn about the usefulness of the seatbelt, what happens to a parachutist as he/she jumps off an aeroplane and many more. The majority (92% ) of the sample agreed that Physics has many everyday application. In Chemistry, the learners learn how ammonia ( used to make cleaning agents) is manufactured, why certain elements rust before others, the chemicals used to make bleach and many more. Over half the sample (64%) of the sample agreed that Chemistry has many everyday application.

When asked if the topics covered in Physics and Chemistry were interesting, 66% of the learners agreed that the Physics curriculum and the Chemistry curriculum has interesting topics.

In Physical Science, the topic is explained to the learners and application exercises are given to the learners . These exercises include mathematics and explanations. They test the learners knowledge on the understanding of the topic. When divided into Physics and Chemistry, 78% of the learners enjoyed the Physics lessons and 80% of the learners enjoyed the application exercises while 59% of the learners enjoyed the Chemistry lessons and 66% of the learners enjoyed the application exercises.

Once the topic has been covered, tests were conducted in class to determine whether the concepts were fully understood. When asked if tests made them nervous, it was found that 84% of the sample, (21 boys and 21 girls), stated that the Physics tests made them nervous while 67% of the sample, (16 boys and 17 girls), stated that the Chemistry tests made them nervous.

This is represented in graphs 4.4 and 4.5.

Figure 4.4

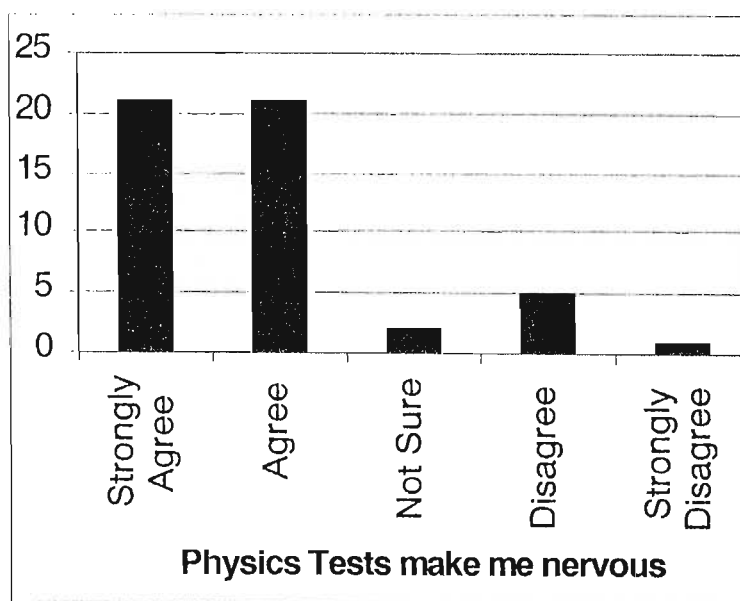
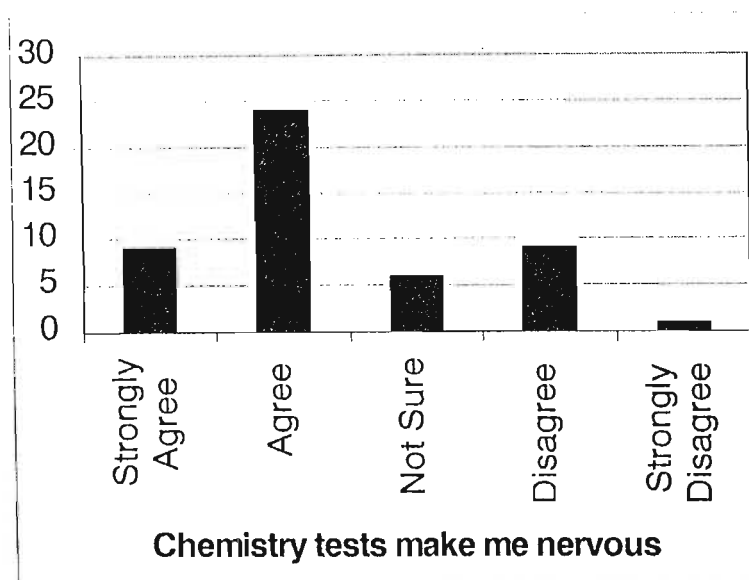




Figure 4.5



When a learner enters Grade 10, he/she has to make a subject choice. The course selected has to be studied in Grade 10,11 and 12 and it determines the career choice. In Sastri College, the learners study Physical Science with Computer Studies or Physical Science with Accounting. A course in Physical Science and Computer Studies allows the learner to choose a career in Computers, Engineering or Medicine while a course in Physical Science and Accounting allows the learner to choose a career in Commerce, Engineering or Medicine. These two courses gave the learners a wide career choice. When asked if they needed Physics and Chemistry to go to university, 60% of the sample indicated that

they needed Physics to go to the university while 58% needed Chemistry to go to University. (See table 4.3 and 4.4).

Table 4.3

	Frequency	Percent
Strongly Agree	13	26.0
Agree	17	34.0
Not Sure	4	8.0
Disagree	13	26.0
Strongly Disagree	3	6.0
TOTAL	50	100.0

**I need Physics to go to University.**

Table 4.4

	Frequency	Percent
Strongly Agree	5	10.4
Agree	14	29.2
Not Sure	6	12.5
Disagree	16	33.3
Strongly Disagree	7	14.6
TOTAL	48	100.0

**I need Chemistry to go to University.**

About half the learners needed Physics in their future career while 32% needed Chemistry in their future career.

From the above, it can be concluded that a greater number of learners found the Physics more interesting than the Chemistry aspect of the Physical Science Curriculum. The learners enjoyed explaining concepts in Physics but not in Chemistry. They also found that the topics in Physics were more interesting than those covered in Chemistry and that Physics had more everyday applications. A greater number of the sample found the Physics lessons and the application exercises more enjoyable when compared to Chemistry. One of the reasons for the dislike of Chemistry (from the open-ended questions), was that there were too many equations and formulae to learn.

### **4.3 QUALITATIVE ANALYSIS OF THE INTERVIEW**

#### **WHY DO LEARNERS HAVE THESE ATTITUDES?**

##### **4.3.1 INTERVIEW WITH LEARNERS WHO LIKED PHYSICS**

The interviewees studied Physical Science because they needed it to enable them to pursue their career. Two interviewees studied Physical Science and Accounting as this allowed them to choose a career in either the Science or the Commerce field whereas

another interviewee studied a course in Physical Science and Computers which will allow him to study a career in Science or Computers.

The focus group liked Physics . They found it simple and challenging. They enjoyed the calculations and the application exercises. They stated that Physics explained things to them. They liked mathematics and stated that their knowledge of mathematics assisted them in the Physics calculations.

They found that Chemistry required more studying than Physics. Chemistry was last done in the Grade 12 syllabus and this allowed them less time to prepare these sections for the examinations. Interviewees i, iii and v stated that they disliked Chemistry because of the vast quantity, while interviewees ii, iv and vi stated that there were too many equations to learn, the contents were not as interesting as Physics and Chemistry contained very little mathematics.

In Grade 11, Inorganic Chemistry was taught at the end of the year. They found this section difficult. They suggested a shuffle in the order in which the content was taught. They suggested that Redox Reactions and Le Chatelier's Principle should be taught in Grade 11 instead of Grade 12 as these topics enabled them to understand Inorganic Chemistry.

Although the learners found Chemistry difficult, they learnt the subject matter so that their results will be good. To overcome the barrier and to enable them to learn Chemistry, interviewees iv studied the sections in a different order to allow him to understand the subject matter, for example, Redox Reactions before Inorganic Chemistry while interviewees v and vi worked out questions from the Physichem (a booklet with Grade 12 Physical Science question papers and answers from the nine provinces of South Africa).

Physics involves the explanation of concepts. Interviewees ii and iv found it difficult to give explanations while interviewees i, iii and vi stated that if the concept is understood, then it was easy to give explanations. The interviewees found the class tests helpful. It made them learn the section and it made them aware of their weaknesses, the different types of questions of time management.

The interviewees stated that the boys and girls have the same ability to study Physical Science and they produce results of a high standard.

#### **4.3.2 INTERVIEW WITH LEARNERS WHO LIKED CHEMISTRY**

These interviewees, like those who liked Physics, studied Physical Science to enable them to pursue their career choice. Interviewees iii and v stated that their subject course enabled them to choose from a wide range of careers. Interviewees i wanted to study in

the Medical Field, while interviewee ii wanted to study a career in the Health Sciences and interviewees v wanted to study Actuarial Science.

The focus group liked Chemistry. They found it interesting, easy to grasp and understand. They enjoyed the experiments. All interviewees liked mathematics and this assisted them in the mathematical aspect of Chemistry. The sections they found interesting were Organic Chemistry, Acid Base Reactions and Chemical Equilibrium. They found these interesting and easy to understand. Interviewees iii, iv and v enjoyed the calculations based on Equilibrium Constant.

The focus group found Physics difficult. There were too many calculations involved in Physics and they found it difficult to learn concepts. Interviewees i and ii found it difficult to give explanations. They studied Physics as they were concerned about their results.

The sample found the class tests useful. It prompted them to learn the section and this made it easier to prepare for the examinations. They became aware of the different types of questions and it made them aware of their weaknesses.

The focus group stated that Physics had a lot of calculations when compared to the giving of explanations. The explanation questions were based on the application of Laws. The

interviewees like those who liked Physics, stated that the girls and boys had the same ability to produce good results.

4.4 THE QUANTITATIVE ANALYSIS OF THE LEARNER’S PERFORMANCE

In Physics and Chemistry, I used three sets of results. The first was a class test, the second the trial examination and the third was the final examination. In Physics and Chemistry, the trial results were poor and they do not correspond to the test and final results. For this reason, the trial results will not be discussed.

In Physics, the test and the final results produced 10% of A symbols, (3 boys and 2 girls). The C symbol was obtained by 20% of the sample for the test(6 boys and 4 girls) and 22% of the sample for the final examination(6 boys and 5 girls). See graph 4.6 and 4.7.

Figure 4.6

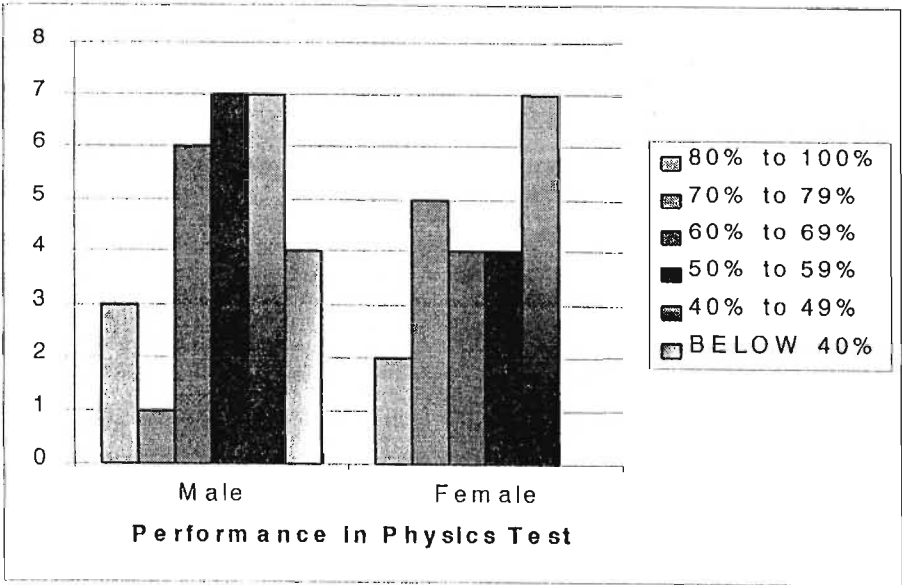
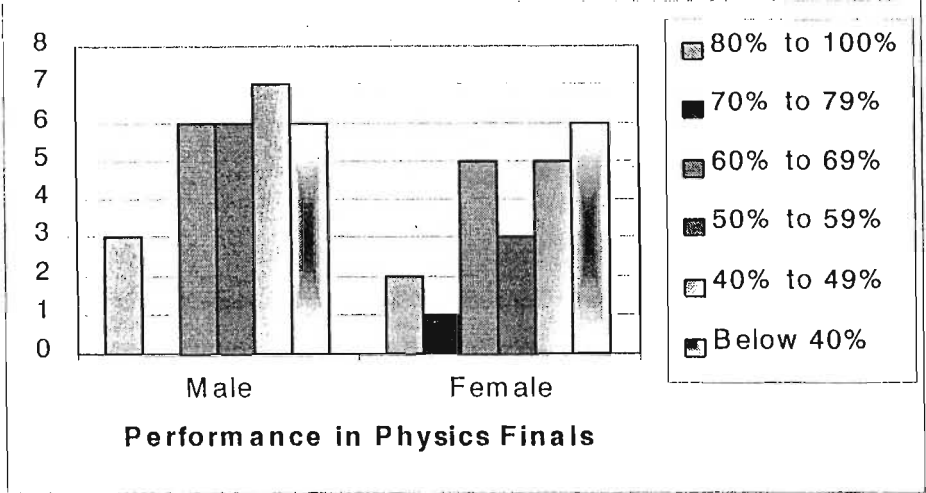


Figure 4.7



In Chemistry, 12% of the sample , (3 boys and 3 girls), produced A symbols for the test and 14% of the sample, (3 boys and 4 girls), produced the A symbol in the final examination. The B symbol, for the test and the finals, was produced by 10% of the sample while the C symbol was produced by 10% for the test and by 8% for the finals.

See table 4.5 and 4.6.



Table 4.5

Performance	Frequency	Percent
80% TO 100%	6	12.0
70% TO 79%	5	10.0
60% TO 69%	5	10.0
50% TO 59%	10	20.0
40% TO 49%	8	16.0
BELOW 40%	16	32.0
TOTAL	50	100.0

#### Performance in Chemistry Test

Table 4.6

Performance	Frequency	Percent
80% TO 100%	7	14.0
70% TO 79%	5	10.0
60% TO 69%	4	8.0
50% TO 59%	3	6.0
40% TO 49%	12	24.0
BELOW 40%	17	34.0
TOTAL	5	100.0

#### Performance in Chemistry Finals

The results for the boys and the girls were very similar. This reveals that they have the same capabilities. This is not according to the study carried out by Levin et al (1991), who stated that boys perform better than girls. Stewart (1998) quotes Masson (1995), who state that although boys dominate physics, the pass rate are higher for girls than boys. This shows that better learners are studying subjects with less influence from the forces that cause gender stereotype.

I will now discuss the relationship between performance and attitude. For this, I used the sample chosen for the interview. Six learners who preferred Physics to Chemistry were interviewed. If they had a positive attitude towards physics, they should perform better in Physics than in Chemistry. It was found that three learners performed better in Physics and three performed better in Chemistry. Five learners who preferred Chemistry to Physics were interviewed. It was found that three learners performed better in Chemistry and two performed better in Physics. (Refer to Table 4.7 and 4.8)

Table 4.7

Interviewees	Physics	Chemistry
I	96	84
Ii	64	75
Iii	67	62
Iv	92	94
V	64	60
Vi	71	82

Performance in final examination (Focus group : Physics)

Table 4.8

Interviewees	Physics	Chemistry
I	67	71
Ii	67	72
Iii	55	46
Iv	28	19
V	61	81

Performance in final examination (Focus group : Physics)

#### **4.5 Conclusion**

A number of important findings have resulted from this study. It was found that a great number of the learners enjoyed Physics more than Chemistry. The reason for their dislike for Chemistry was that the quantity to study was too vast. There were too many equations to learn, the content was not as interesting as Physics and that Chemistry contained very little calculations. Those who did not like Physics, found the calculations in Physics difficult. They could not learn and understand all the concepts and Laws.

There was no significant gender difference in the learners performance. It was also found that there was no significant relationship between attitude and performance. Despite their poor attitude towards one of the components of Physical Science, the learners still performed well.

## **CHAPTER 5**

### **INTERPRETATION, LIMITATIONS AND RECOMMENDATIONS**

#### **5.1 INTRODUCTION**

This chapter will represent the main findings discussed in the previous chapter. It will also indicate the limitations of this study and it will contain recommendations for both Science educators and Science subject advisors.

#### **5.2 INTERPRETATION**

In South Africa, the Physical Science curriculum has two components, Physics and Chemistry. The learners write two separate examination papers. In this study, it was reported that the majority of the learners had a positive attitude towards Physics. The Physics syllabus contains a large amount of calculations. It also has explanations and the stating of Laws. These learners enjoyed mathematics, therefore they had a positive attitude towards Physics. These learners also found the content of the Physics syllabus interesting and applicable to their lives. The Physics aspect of Physical Science is taught during the first two terms in Grade 12. The learners had a lot of time to prepare these sections for the examinations.

The reasons given for the negative attitude towards Chemistry was understandable. Inorganic Chemistry was taught in the last term in Grade 11. The content of this section is vast and it contains approximately 50 equations for the learner to study. They have very little time to prepare this vast quantity for the examination. The learners get frustrated learning this section, hence their negative attitude towards Chemistry.

In the final Examination result sheet, the learners are given one mark for Physical Science. The results from the two papers are added and represented as one. Despite their negative attitude towards one of the components of Physical Science, learners performed well in the examinations. Some the members from the focus group obtained A symbols for Physical Science. This shows that the learners worked hard to prepare for Physics and Chemistry. The reason of this was that their performance determined their ability to enter a tertiary institution to study for a career. This shows that although learners had a negative attitude towards one component of Physical Science, they studied both components. This tells us that they overcame their negative attitude to obtain a pleasing end result. This finding is contradictory to those obtained in the study of Schibeci & Riley (1986), in which it was found that attitude supports achievements.

There was no gender difference in the performance in Science. This finding does not support the study carried out by Levin, Sabar & Libman (1991) which found that boys perform better in Physical Science.

### 5.3 LIMITATIONS OF THE STUDY

1. The study was conducted in one site, Sastri college and the sample consisted of 50 learners who study Physical Science in Kwa Zulu Natal, one of the nine provinces in South Africa. Despite the use of the small sample, there is no reason to suppose that the other Physical Science will hold different views from the sample.
2. The instruments used need improvement. It was compiled largely from literature reading and the assistance of my supervisor. There was no validated instrument during the period of this research.
3. I was unable to conduct a semi-structured interview with the learners who preferred Chemistry to Physics. If this was possible, the interview may have revealed more about the learners attitude towards Chemistry.
4. I was unable to obtain relevant literature related to the study, that was conducted in South Africa. This suggests to me that perhaps very little or no research has been done on learners attitude towards Physics and Chemistry.
5. The lack of skill and experience on my part in conducting the interviews was also a handicap. This prevented me from obtaining all the information I needed.

## 5.4 RECOMMENDATION

From the findings of my study, I make the following recommendations.

1. The order of the Chemistry syllabus needs to be changed. Redox Reactions and Le Chatelier's Principle must be taught in grade 11. These two sections will enable the learner to grasp and understand the Inorganic Chemistry section. The section will then be enjoyed by more learners and will assist in the changing of their attitudes towards Chemistry. Subject advisors should make this recommendation to all Science Educators.
2. To assist in making Chemistry more interesting, computers can be used. Swanson (1995) found that the use of computers in his lessons provided images, simulation of experiments and problems. His learners enjoyed and understood the lesson. Harwood & McMahon (1997) found that a video series brought the abstract, distant word of science into clear focus. The learners developed a more positive attitude towards Chemistry and they began to relate the Chemistry to the world around them. The use of computers and a video series will make Chemistry a visual science. The learners will find Chemistry more interesting.



3. The reason for the negative attitude towards Physics is the difficult calculations. More time must be spent with these learners to enable them to understand and carry out these calculations. The Science educator must seek the assistance of the Mathematics educator.
4. Subject Advisors, Principals and the governing bodies must provide educators with the necessary professional reinforcement to teach Science ( Shrigley ; 1977). They can assist the educator in the preparation of Science materials, and provide INSET programmes to improve the educator's teaching skills, such as oral questioning and teaching strategies.

## BIBLIOGRAPHY

Aiken, L.R. & Aiken, D.R. (1969) **Recent Research on Attitudes Concerning Science**. Science Education, Vol. 53, p. 295-305.

Atkinsola.P. (1958) **Reducing Anxiety in the Science Class**. Education Research, Vol. 28, p. 146-149.

Ayers, J.B. & Price, C.O. (1975) **Children's Attitude towards Science**. School Science and Mathematics, Vol. 75, p. 311-318.

Behr, A.H., Cherian, V.I., Mwamwenda, T.S., Ndaba, E.P. & Ramphal, A. (1986) **An Educational Psychology for Schools in South Africa**. Durban: Butterworth.

BouJaoude, S.B. (1992) **Relation between student's in Strategies and the Change in their Misunderstandings during a High School Chemistry Course**. Journal of Research in Science Teaching, Vol. 29, p. 687-699.

Crabtree, B.F. & Miler, W.L. (1992) **Doing Qualitative Research**. London: Sage publications.

Denzin, N.K. & Lincoln, Y.S. (1994) **Handbook of Qualitative Research**. London: Sage Publications.

Dickinson, V.L. & Flick, L. (1996) **How to Succeed in Physics Without really Crying**. Science and Children, Vol. 33, No. 8, p 37-38.

Ebenezer, J.V. & Zoller, U. (1993) **Grade 10 student's Perception of and Attitudes towards Science Teaching and School Science**. Journal of Research in Science Teaching, Vol. 30, No. 2, p. 175-186.

Gallagher, J.J. (1971) **A Summary of Research in Science Education for the years of 1968-1969**. Research Review Series, Paper 6. Science Education, June 1971. P. 149-168.

Guzzetti, B.J., Hynd, C.R., Skeels, S.A. & Williams, W. O. (1995). **Improving Physics Texts : Students Speak out**. Journal of Reading, Vol. 38, No.8, p. 656-666

Habraken, C.L. (1996) **Perceptions of Chemistry: Why is the Common Perception of Chemistry, the most visual of Sciences, so distorted?** Journal of Science Education & Technology, Vol. 5, No. 3, p. 193-201.

Haladyna, T. & Shaughnessy, J. (1998) **Problems in assessing student Attitudes on Science Education**. A Partial Solution. Science Education. Vol. 66, No. 4, p. 547-563.

Haney, R.E. (1964) **The Development of the Scientific Attitudes**. Science Teacher, Vol. 31. P. 33-35.

Harwood, W.S. & McMahon, M.M. (1997) **Effects of Integrated Video Media on Student Achievement & Attitudes in High School Chemistry**. Journal of Research in Science Teaching, Vol. 43, No.6, P. 617-631.

Hobden, P.A. (1984) **A Study of the Aims and Effects of Chemistry practical Work in Indian Secondary Schools at the Senior Certificate level**. Durban : University of Natal.

Johnson, R.T., Ryan, F.L. & Schroeder, H. (1974) **Inquiry and the Development of the Positive Attitude**. Science Education, Vol. 58, No. 1, p. 51-56.

Jihson, A.H., Morrison, T.I. & Sharp, D.W.A. (1971) **Topic Difficulties in Chemistry**. Education in Chemistry, Vol. 6, p. 212-213.

Koballa, T.R. & Crawley, F.E. (1985) **The Influence of Attitude on Science Teaching and Learning**. School Science and Mathematics, Vol. 85, p. 222-232.

Lawrenz, F. (1976) **The Prediction of Student Attitude towards Science from Student Perception of the Classroom Learning Environment**. Journal of Research in Science teaching, Vol. 13, p. 509-515.

Lawrenz, F. (1975) **The Relationship between Science Teacher Characteristics and Student Achievements and Attitude.** Journal of Research in Science Teaching, Vol. 12, p 433-437.

Levin, T, Sabar, N & Libman, Z. (1991) **Achievements and Attitudinal Patterns of Boys and Girls in Science.** Journal of Research in Science teaching. Vol. 28, p. 315-328.

Mc Millian, J.H. & May, M.J. (1979) **A study of Factors influencing Attitudes towards Science of Junior High School Students.** Journal of Research in Science Teaching, Vol. 16, No. 3. P. 217-222.

Mc Robbie, C.J.& Fraser, B.J. (1993) **Associations between Student Outcomes and Psychosocial Science Environment.** The Journal of Education Research, Vol. 87, No.2, p. 78-84.

Miles, M.B. & Huberman, A.M. (1994) **An Expanded Sourcebook - Qualitative Data Analysis.** London: Sage Publications.

Mungy, H. (1983) **Thirty Studies involving the “ Scientific Attitude Inventory”. What confidence can we have in this onstrument?** Journal of Research in Science Teaching, Vol. 20, No. 2, p. 141-162.

Pedersen, J.E. (1992) **The Effects of a Co-operative Controversy, Presented as a STS Issue,**

**on Achievement and anxiety in Secondary Science.** School Science and Mathematics, Vol. 92, No. 7, p. 374-380.

Powell, J.D. (1962) **High School Seniors' Attitudes towards Science.** NASSP Bulletin Year, Vol. 46, p 82-87.

Rasanen, L. (1992) **Girls and the Learning of Physical Concepts.** European Education, Vol. 24, No. 3, p. 83-96.

Reynolds, K. (1994) **Toys for Boys and Girls.** Science Scope, Vol. 17, No. 6, p. 64.

Robinson, G.M., (1998) **Methods and Techniques in Human Geography.** England John Wiley and Sons.

Schibeci, R.A. & Riley, J.P. (1986) **Influence of students' Background and Perceptions on Science Attitudes and Achievements.** Journal of Research in Science Teaching. Vol. 23, No. 8, p. 177-187.

Shrigley, R.G. (1983) **Persuade, Mandate & Reward : A Paradigm for Changing the Science Attitudes and Behaviour of Teachers.** School Science and mathematics, Vol. 83, No. 3, p. 204-215.

Shrigley, R.L. (1978) **The Persuasive Communication Model : A Theoretical Approach for Attitude change in Science Education.** Journal of Research in Science Teaching, Vol. 15, No. 5, p. 335-341.

Shrigley, R.L. (1990) **Attitudes and Behaviour are Correlates**. Journal of Research in Science teaching, Vol. 27, No. 2, P. 98-113.

Shrigley, R.L., Koballa, T.R. (Jr) & Simpson, R.D. (1998) **Defining Attitude for Science Educators**. Journal of Research in Science Teaching, Vol. 25, No. 8, P 659-678.

Shrigley, R.L. (1977) **The Function of Professional Reinforcement in Supporting a more Positive Attitude of Elementry Teachers towards Science**. Journal of Research in Science Teaching, Vol. 14, No. 4, p. 317-322.

Singh, S.S. et al. (1990) **Diamond Jubilee Brochure: Sastri College**. Durban : Atlas Printers.

Smith, C.J. (1987) **A Study of Students' Understanding of the Concepts of Chemistry within the South African Joint Matriculation Board Syllabus**. Johannesburg : University of Witwatersrand.

Staberg, E. (1994) **Gender and Science in the Swedish Compulsory School**. Gender and Science, Vol. 6, No. 1,p. 35-45.

Stevenson, R. (1995) **Will Chemistry Survive?** Education in Chemistry, Vol. 28, p. 146-149.

Stewart, M. (1998) **Gender Issues in Physics Education**. Educational Research, Vol. 40, p.283-293.

Swanson, C.B. (1995) **How Technology in the Chemistry classroom Affects Students' Attitudes and Motivation**. Teaching and Change, Vol. 3, No.1, p. 63-75

Tolmie, A. & Howe, C. (1993) **Gender and Dialogue in Secondary School Physics**. Gender and Education, Vol. 5, p. 191-204.

Willson, V.L. (1983) **A Meta-Analysis of the Relationship between Science Achievement and Science Attitude: kindergarden through College**. Journal of Research on Science Teaching, Vol.20, No.9, p. 839-859.

Yore, L.D. (1991) **Secondary Science Teachers' Attitudes towards and beliefs about Science Reading and Science Textbooks**. Journal of Research in Science Teaching, Vol. 28, p. 55-72.



## **APPENDIX 1**

### **QUESTIONNAIRE** **STUDENTS ATTITUDES TOWARDS SCIENCE**

This questionnaire is to assist me to determine the attitudes learners display towards Physics and Chemistry. Each question has 5 alternatives: strongly agree (1), agree (2), not sure (3), disagree (4), strongly disagree (5). Please choose the alternative which best reflects your feelings on each of the items. I appreciate the time you have taken to answer the questionnaire. All the best in your final examinations. Your responses are confidential.

#### **A. Biodata**

Tick the appropriate block.

1. Would you regard yourself as:

(a) In the top 10% of your Physical Science class.	
(b) In the bottom 10% of your Physical Science class.	
(c) In the top 25% of your Physical Science class.	
(d) In the bottom 25% of your Physical Science class.	
(e) An average learner, in the middle/half of your Physical Science class.	

2. Gender

Male	
Female	

## B. YOUR FEELINGS ABOUT PHYSICS

	OPTIONS (Tick one per item)				
	Strongly agree	Agree	Not sure	disagree	Strongly disagree
1. I would not take Physics if it were not included in Physical Science.					
2. I enjoy learning Physics.					
3. Physics has more a negative than positive effects on human life.					
4. Physics is difficult to understand.					
5. I enjoy Physics because of the mathematics included in the subject.					
6. Physics is difficult because of the explanations required of me as a student.					
7. I find terminology of Physics difficult to learn.					
8. Physics is more beneficial to humans than chemistry.					
9. Physics experiments are very interesting.					
10. Physics has many everyday applications.					
11. Physics is a subject that I will rarely use in my daily life after leaving school.					
12. It is necessary to learn Physics to be a good citizen.					
13. I have a good feeling towards Physics.					
14. In the Physics class, we do fun activities.					
15. Interesting topics are not covered in the Physics class.					
16. I enjoy the Physics lesson.					
17. If the Physics is difficult, I tend to give up.					
18. I enjoy the application exercises in Physics.					
19. Physics tests make me nervous.					
20. I do not look forward towards my physics lesson.					
21. If I had a choice, I would not do Physics again.					
22. I need Physics to go to University.					

	Strongly agree	Agree	Not sure	disagree	Strong disagree
23. I expect to use Physics in my future career.					
24. Even when I can do the Physics I do not like it.					
25. I like it when there is something new to learn in Physics.					
26. I do not enjoy my Physics practical lessons.					
27. I sigh with relief when my Physics lesson is over for the day.					
28. I am always keen to start my Physics lesson.					
29. Physics is only important in a few careers.					
30. Physics never gets boring.					
31. At the end of the Physics lesson, I feel good because I know what is happening.					
32. I am surprised if I get a lot of physics right.					
33. I usually understand a new idea in physics very quickly.					
34. Physics is one of my weaker subjects.					
35. At the end of a physics lesson, I feel I understand things better.					

### C. YOUR FEELINGS ABOUT CHEMISTRY

	Strongly agree	Agree	Not sure	disagree	Strong disagree
1. I would not have taken Chemistry if it were not included in the Physical Science.					
2. Chemistry is bad for the environment.					
3. I enjoy the Chemistry lessons.					
4. Chemistry is difficult to understand.					
5. Chemistry is difficult to understand because of the Mathematics included in the subject.					
6. I enjoy Chemistry because of the explanations I have to give.					
7. I find the terminology of Chemistry difficult to learn.					
8. Chemistry is more beneficial to humans than Physics.					
9. Chemistry experiments are very interesting.					
10. Chemistry has many everyday applications.					
11. Chemistry is a subject I will really use in my daily life after leaving school.					
12. It is necessary to learn Chemistry to be a good citizen.					
13. I have a good feeling towards Chemistry.					
14. If the chemistry is difficult, I tend to give up.					
15. Chemistry tests make me nervous.					
16. In the Chemistry class, we do fun activities.					
17. I enjoy the Chemistry lessons.					
18. I enjoy the application exercises in Chemistry.					
19. I do not look forward to my Chemistry lesson.					
20. Interesting topics are covered in the Chemistry class.					

	Strongly agree	Agree	Not sure	disagree	Strong disagree
21. If I had a choice, I would not take Chemistry again.					
22. I need chemistry to go to university.					
23. I expect to use Chemistry in my future career.					
24. Even when I can do the Chemistry, I do not like it.					
25. I like it when there is something new to learn in Chemistry.					
26. I do not enjoy my Chemistry lessons.					
27. I sigh with relief when Chemistry is over for the day.					
28. I am always keen to start my Chemistry lessons.					
29. Chemistry is only important in a few careers.					
30. Chemistry never gets boring.					
31. At the end of the Chemistry lesson, I feel good because I know what is happening.					
32. I am surprised if I get a lot of Chemistry right.					
33. I usually understand a new idea in Chemistry quickly.					
34. Chemistry is one of my favorite subjects.					
35. At the end of a Chemistry lesson, I feel I understand things better.					

**D 1. Explain, in your own words, why you like or dislike Physics.**


**D 2. Explain, in your own words, why you like or dislike Chemistry.**


## **APPENDIX 2**

### **Semi- Structured Interview**

#### **Physical Science**

Interviewee :

- i. U
- ii. S
- iii. N
- iv. K
- v. D
- vi. T

#### **1. WHY DID YOU CHOOSE PHYSICAL SCIENCE IN GRADE 10,11 AND 12 ?**

U - I want to pursue a scientific career and I enjoy Science.

S - I want to do a career in the medical field.

N - Career choice. With a science course, there are many alternatives. But now I want to do Commerce.

K - I want to do electronic engineering.

D - The science and computers allow me an open field to choose a career.

T - As N.

#### **2. DID YOUR PARENTS INFLUENCE YOUR SUBJECT CHOICE?**

U – No, but advised me.

S – No, but relatives advised me. They told me it involved a lot of work.

N – No, But my sister did Science and she managed, therefore I did Science.

K – No, but we discussed it.

D – No.

T - No.

### **3. WHAT DO YOU LIKE ABOUT PHYSICS?**

U – It is simple. There is no learning (swatting). We learn the concepts and the formulae and apply them.

S – It is challenging. I enjoy working with figures and calculations are interesting.

N - There are many formulae to learn, but the application is easy.

K - The content is reasonable. It explains what is happening around us.

D - I enjoyed the electricity section for it explains things about electricity to us.

Chemistry requires more studying while Physics is more practical.

T – I enjoyed mathematics and therefore the calculations involved in Physics. Physics explains things to us. Chemistry involves too much of learning and we do this last in the syllabus.

### **4. DO YOU ENJOY MATHEMATICS AND DOES IT ASSIST IN PHYSICS?**

U - Yes. It makes the Physics calculations easier.

S - Yes. It assists in the Physics calculations.

N - Yes. Graphs in mathematics assist in the graphs in motion.

K - Yes. The sin and cosine rule assist in the calculations in Vectors.



D - Yes. Changing the subject of the formula is made easier with the mathematics knowledge.

T - Yes. The graphs and mathematics skills become sharper and the concepts in Physics are easier.

## **5. WHAT IS IT ABOUT CHEMISTRY THAT YOU DO NOT LIKE?**

U - Too much to learn and not as interesting as Physics.

S - There is too much to learn and it is difficult as it is not of practical use.

N - There is too many equations and formulae to learn.

K - The quantity is too vast.

T - Too many equations and very little mathematics.

The learners felt the grade 11 work to be difficult, as they did not understand it. The redox reactions and Le Chatlier's Principle taught in grade 12 should be taught in grade 11 as this made inorganic chemistry easy to understand and learn.

## **6. DID YOU GIVE UP IF THE CHEMISTRY WAS DIFFICULT?**

U - Yes but it was for a while. I had to get up and try again for my performance will affect my final results.

As my learning skills improved, it assisted me in the learning of chemistry.

S - I did not lose interest, therefore I always do my Physics before my Chemistry.

N - I was forced to learn the chemistry because there is a vast amount of inorganic in the question papers.

D - No. I had to learn them in a different order, redox before organic.

K - No. I worked through Physichem and this gave me an idea of the different types of questions.

T - I was forced to learn. Physichem did help but the pattern in the papers changes and this made me learn.

## **7. DO YOU THINK THAT GIVING OF EXPLANATIONS IS DIFFICULT?**

U - When a concept is understood, it is easy to give an explanation.

S - I find it difficult to put things into words.

N - If concept is understood, then it is easy.

D - I find it difficult to give explanation.

K - I enjoy giving explanations.

T - If the concept is known, then it is easy to give explanations.

## **8. IS THE WORKLOAD IN PHYSICAL SCIENCE VAST?**

U - No.

S - Not too much. The grade 11 work was a lot.

D - Yes but it is different for different subjects. Biology has a lot to learn.

K - Yes, I agree with D but I find the English has a vast workload.

T - It looks a lot but it involves doing examples.

**9. WHAT ASPECTS OF PHYSICS DO YOU LIKE THE MOST?  
WHY DO YOU SAY SO?**

U – Graphs and equations of motion. It is practical and it relates to everyday things.

S – Newtons Laws. I understand the laws and I enjoy the calculations.

N – Equations of motion. It is practical. I enjoy drawing the graphs.

D – Vectors. The calculations with planes and ships relate to real situations. I understand the directions.

K – Work, Energy and Power. I enjoy the calculations.

T – Newtons Laws and Universal Gravitation. I enjoyed the pulley system calculations.

**10. DO YOU THINK THE CLASS TESTS ASSIST IN THE PREPERATION  
OF THE EXAMINATIONS?**

U – Yes. We come across various examples.

S - Yes. It forces us to learn and the tests prepare you for the end of the year examinations.

N – Yes find out the errors we made. It showed us our weaknesses. The class tests were not very difficult, and yet we made errors. We put this right.

D – I was not fully prepared for the class tests.

K – Yes. We saw different types of questions and we had to change the subject of the formula.

T – Yes. I did well in the class tests and I knew that I could do more. I learnt time

management. When we learn for tests, it becomes easy to learn for an examination. I felt confident.

#### **11. DID YOUR GRADE 7, 8 AND 9 SCIENCE TEACHER INFLUENCE YOUR SUBJECT CHOICE?**

U – I did not enjoy my Junior Secondary Science. The explanations given were poor.

The teacher did not influence me but I liked the subject.

S – I found the science to be exciting and enjoyable. The teacher did not influence me.

N – Yes. My grade 7 science was very enjoyable. I did not enjoy my grade 9 science as I was in a new school and I did not know the teacher.

D – I did not enjoy my Junior Secondary science. The subject matter was all mixed up. We did the fish, rat, oxygen, nitrogen, metals, etc.

K – I enjoyed the Biology aspect more than the Physical Science aspect in grade 9.

T – I did not understand the teacher, therefore I did not enjoy the Science. I had to change my attitude.

#### **12. DO YOU FIND THAT CHEMISTRY HAS A LOT OF EXPLANATIONS?**

U - Yes. Too much is needed.

S - Yes. A lot of theory questions.

N - A lot of formulae but no explanation.

K – No. The writing of the equations was difficult.

### **13. DO YOU SEE SCIENCE AS AN INTELLECTUAL SUBJECT?**

U – Yes. You get teased about it.

S – Yes. I was teased nerd/brain.

N – Yes. You have to be clever. It requires a lot of thinking.

D – Yes. It requires a lot of swatting.

K – Yes. I was teased about it.

T – Yes. Physical Science requires a lot of thinking.

Some of the commerce learners ignored us even though we were together in

Grade 7, 8 and 9.

### **14. IS THE WORKLOAD IN SCIENCE THE SAME AS THAT IN COMMERCE?**

U – There is much more to do.

S – Physical Science has more application than commerce but commerce has a large content.

D – The workload is the same.

T – The workload is the same.

### **15. DOES THE PHYSICAL SCIENCE REQUIRES CONSTANT WORK?**

U – Yes. You have to work on a daily basis. This reduces the tension towards the examinations.

S – Constant work assist in the final examinations.

N, D, K, T – all agree with above.

## **16. DOES THE GENDER OF THE LEARNER AFFECT YOU?**

U – No. Girls and boys have the same ability to study.

S – There was no problem with gender.

N – No. The boys pay more attention in tuition than the class. The girls are just as good in mathematics and in Science. Y(a girl) always topped the mathematics class.

D – Girls did well in the languages than in the Maths and Science.

K – Girls always pay attention in the class while the boys get up to mischief.

They both have the same ability.

T – No. The boys disturb the lesson but after the lesson, they ask us for explanations.

Both genders do well. X(a boy) and Y(a girl) were both good in the mathematics and Science class.

## **APPENDIX 3**

### **INTERVIEW**

### **CHEMISTRY**

**Interviewee :**

- i. C
- ii. A
- iii. D
- iv. N
- v. K

#### **1. WHY DID YOU CHOOSE SCIENCE IN GRADE 7, 8 AND 9 ?**

C – Career choice – medical field.

A – Career – health sciences.

D – Career – Wide range of careers to choose from when doing science.

N – Career.

K – Career – wide range of career to choose from. I have decided to do Actuarial Science.

#### **2. DID YOUR PARENTS INFLUENCE YOUR CHOICE ?**

C – personal choice

A – personal choice

D – personal choice

N – personal choice

K – personal choice

### **3. WHAT DO YOU LIKE ABOUT CHEMISTRY?**

C – I enjoy the experiment and the equations.

A – the theory and the explanations are easy to learn.

D – I find it interesting.

N – I enjoy the practicals and the subject is interesting.

K – it is easy to grasp and understand. It is more practical and I can relate.

### **4. DO YOU LIKE MATHEMATICS ?**

C – Yes.

A – Yes. It assists in Physical Science.

D – Yes.

N – Yes.

K – Yes.

### **5. WHAT IS IT ABOUT PHYSICS THAT YOU DO NOT LIKE?**

C – I get the calculations incorrect and I find the difficult.

A – It is not a learning subject, it is an application subject. There is no pattern.

D – Learning of the concepts.



N – There is too much calculations.

K – I enjoy Chemistry more the Physics. Physics is more difficult.

#### **6. DID YOU GIVE UP WHEN THE PHYSICS WAS DIFFICULT?**

C – No. I was worried about my matric results.

A – No. I was worried about my matric results.

D – No. I was worried about my matric results.

N – No. I was worried about my matric results.

K – No. I overcame my fear. I try as much as I can because I want to do well. I feel good when I succeed.

#### **7. DO YOU FEEL THAT THE GIVING OF EXPLANATIONS IS DIFFICULT?**

C – I find that giving an explanation is difficult. Finding the right science words to use is difficult.

A – Yes. At times I do not understand the questions, therefore the answers do not match the questions.

D – No, I enjoy giving explanations.

N – No.

K – Not very difficult. It is similar to Physics.

#### **8. IS THE WORKLOAD IN PHYSICAL SCIENCE A LOT?**

C – No.

A – No.

D – Yes. A lot of time is needed to improve the percentage. With practice, it becomes better.

N – No.

K – No. There are more applications and not much learning. It is on par with other subjects.

**9. WHAT ASPECT OF CHEMISTRY DO YOU LIKE THE BEST?  
WHY DO YOU LIKE THIS SECTION?**

C – Organic chemistry. I understood and enjoyed the section.

A – Acid-Base reactions. The balancing of equations and I enjoyed the mathematics.

D – Chemical equilibrium. It was simple.

N - Chemical equilibrium. I understood the section. It is related to Industry.

K - Calculation : equilibrium constant and pH. I enjoy mathematics.

**10. DO YOU FIND THE SCIENCE GRAPHS DIFFICULT TO DRAW AND  
UNDERSTAND?**

C - No.

A - At first but with understanding, I enjoyed it.

D - No. It was easier to understand the question. I enjoyed finding relationships.

N - No. It was easy to understand.

**11. DO YOU THINK THAT SCIENCE TESTS ASSIST IN THE PREPARATION OF THE EXAMINATIONS?**

C - Definitely. We come across different types of questions and different aspects that can be tested.

A - Yes. It makes the pathway to the examinations easier. We get an idea of the different types of questions.

D - Yes. It prompted us to learn.

N - Yes. It gave us an idea on what to learn.

K - It allows us to see whether we know or do not know our work.

**12. IS THE PHYSICHEM USEFUL AS A PREPARATION TOOL FOR THE EXAMINATION?**

C - Yes.

A - Yes.

D - Yes.

N - Yes.

K - Yes, we come across different types of questions.

**13. DID YOUR GRADE 7,8 AND 9 SCIENCE TEACHER INFLUENCE YOU IN ANY WAY?**

C - Yes. I enjoyed the lessons.

A - No. Grade 7 and 8 was enjoyable but grade 9 was difficult.

D - No. It was very easy and enjoyable.

N - Yes. I liked science, and the teacher made it enjoyable.

K - No. I enjoyed science.

**14. DID YOU FIND THAT PHYSICS HAS A LOT OF EXPLANATIONS TO GIVE?**

C - No. There were more calculations and laws.

A - Yes. The explanations were on the application of the laws. The questions in Physics were very varied.

D - No. There were more calculations.

N - No. It required more calculations.

**15. DO YOU SEE SCIENCE AS AN ELITE OR INTELLECTUAL SUBJECT?**

C - Yes.

A - Yes.

D - Yes.

N - No.

K - No. But people say that it is hard and difficult. There is extra work to do.

#### **16. IS THE SCIENCE WORKLOAD THE SAME AS COMMERCE?**

C – It is balanced. Commerce has a lot of theory and essays to learn.

A – Yes. Commerce is more theory and science is more application.

D – Balanced. Commerce has more swatting - no understanding is needed while  
Science has more application and it requires understanding.

N – No. The work is more or less the same.

K – The workload is the same.

#### **17. DOES PHYSICAL SCIENCE REQUIRE CONSTANT WORK?**

C - Yes. You understand concepts and calculations better. It helps  
To improve results.

A – Yes. You understand concepts and you come across different kinds  
of questions.

D - Yes. It makes application and understanding better. It improves results.

N - Yes. Prepares you for exams. You understand the concepts and it makes you feel  
good.

K - By doing work at all times at home, it prepares you for the exams.

**18. DOES THE GENDER OF THE STUDENT AFFECT YOU?**

C - No. Girls and boys were the same.

A - No. Girls and boys were treated the same.

D - No, but I found that boys enjoyed science more and girls enjoyed biology more.

N - No. More or less the same.

K - They have equal ability. Science was a career choice.